Introduction

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Gracillariid leafminers in the genus *Phyllonorycter* Hübner have become important pests in most apple-growing regions of the world (Baggiolini 1960, Pottinger & LeRoux 1971, Ujiye 1979, Weires et al. 1980). The dramatic increase in their pest status during the past two to three decades has been associated with the development of insecticide resistance by adult moths (Weires 1977, Van Driesche et al. 1985, Pree et al. 1990). The multivoltine life cycle of pest species of *Phyllonorycter* may have contributed indirectly to their development of resistance and thus to their rapid rise in economic importance.

Prominent pest species include the apple blotch leafminer, *Phyllonorycter crataegella* (Clemens), in eastern North America (Weires et al. 1980, Maier 1981); the spotted tentiform leafminer, *Phyllonorycter blancardella* (F.), in Europe and North America (Baggiolini 1960, Pottinger & LeRoux 1971, Weires et al. 1980, Baumgärtner et al. 1981); *Phyllonorycter corylifoliella* (Hübner) in Europe (Baggiolini 1960); *Phyllonorycter mespilella* (Hübner) (includes *Phyllonorycter elmaella* Doganlar and Mutuura reported from western North American orchards) in Europe and western North America (Barrett & Jorgensen 1986, Varela & Welter 1992, Cossentine & Jensen 1992); and *Phyllonorycter ringoniella* (Matsumura) in eastern Asia (Ujiye 1979). Among North American species of *Phyllonorycter*, only *P. blancardella*, *P. crataegella*, *P. elmaella*, and *P. mespilella* form mines on apples and crab apples, *Malus* spp. (Maier 1985, Maier & Davis 1989, Cossentine & Jensen 1992).

Species of *Phyllonorycter* that infest apple trees in North America complete two to five generations per year (Pottinger & LeRoux 1971,